Numerical Simulation on Sediment and Water Runoff in the Ayeyarwady River Watershed

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1. Background of the Research

1.1 Introduction to the Ayeyarwady River Basin

The Ayeyarwady (Irrawaddy) river which has the length of 2170 km [(2)], the drainage area is about 413,710 sq-km [(2)] and river flows from the Northern mountainous area to the Southern plain area. It can be divided into Upper Basin, Middle and Lower Basin and the Delta area. The climate condition is tropical monsoon climate, the average annual precipitation amount in the dry zone is no more than 1000-mm, the delta area is about 2500-mm and the coastal area is 5000-mm [(3)]. About 1300 km of commercial transportation route is maintained by the river and more than 3,200 km of navigable waterways exist in the delta area.

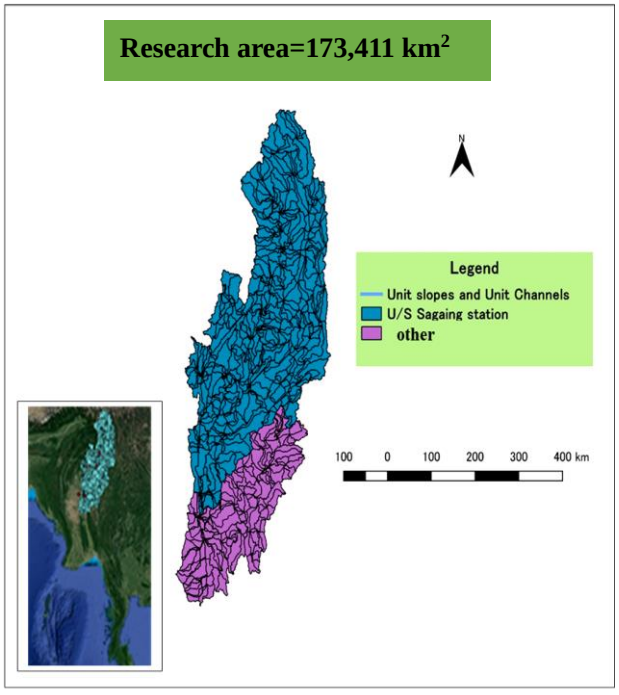

Fig.1 Research area in the Ayeyarwady River Basin

The Ayeyarwady River ranked with the fifth-largest suspended load and the fourth highest total dissolved load in the world's rivers therefore the severe local sediment deposition make trouble for the commercial waterway system. Moreover, as the consequences of climate changes and the impact of natural disasters, the sedimentation problems are seriously occurred in the river basin. From these background, numerical simulation model has been applied to the research area (between Upper and Middle part of the river basin, totally 313 channels) (Fig. 1). In this research, river bed erosion and deposition areas can be discussed by the application of this model.

2. Methodology

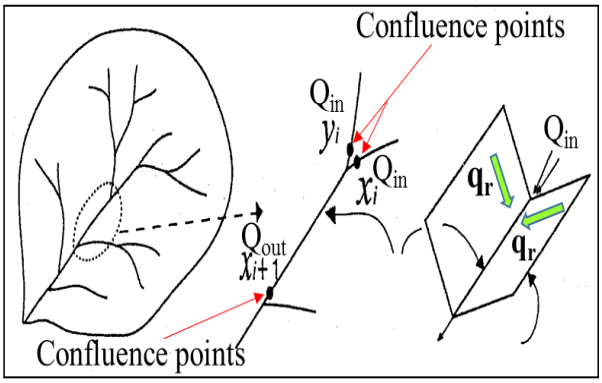

Fig.2 Unit channels and unit slopes by Egashira and Matsuki

The rainfall and sediment runoff model (Fig.2) proposed by Yamanoi and Fujita [(1)] is applied to the research area. Unit slopes and unit channels data were extracted from ASTER GDEM employing GRASS GIS. Satellite-based rainfall data obtained from GSMaP project was modified before conducting the simulation processes by using rain gauge and water discharge data because total rainfall amount didn't match with the rain gauge data. 5 rainfall data and 3 sediment data installed by the Department of

Meteorology and Hydrology (DMH) Myanmar, were used only for the validity verification. The width of the stream channels is set up manually using google satellite map. Fig.3 shows the grain size distribution data at the Sagaing station and only that data is applied for all channels as there has not enough data.

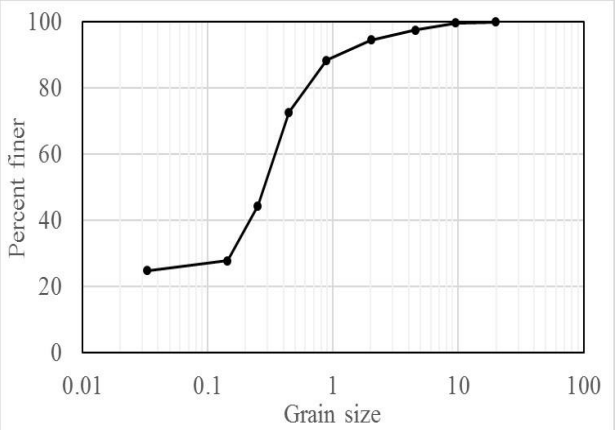

Fig. 3 Condition of grain size distribution of river bed material

3. Simulation Results and Discussion

Fig. 4 shows the simulation results of rainfall runoff at the downstream end of the Sagaing station in the research area. By this result, the calculation results are quite similar with the observation value.

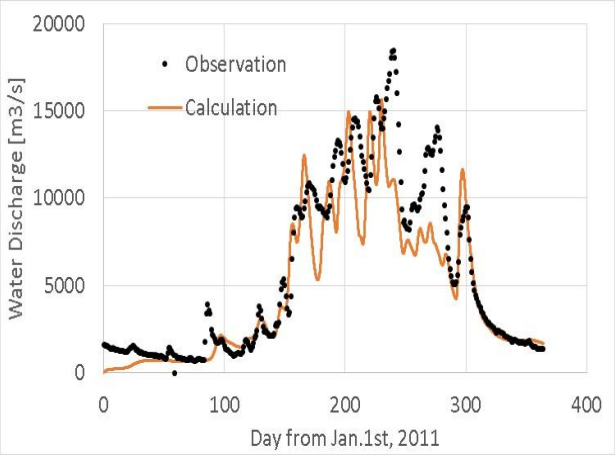

Fig.4 Comparison between calculated and observed water discharge at Sagaing station

River bed deformation results in 2011 is described in Fig.5. According to the results, downstream part is relatively stable than upstream part. About 0.2 m to 5m of erosion occurred in the mountainous areas. Moreover, serious erosion with the range of nearly 10 m also occurred in some channels. To verify the validity of calculation, modification of grain size distribution data has been done. These results show the identification of river bed deformation processes in the research area by using the numerical simulation model.

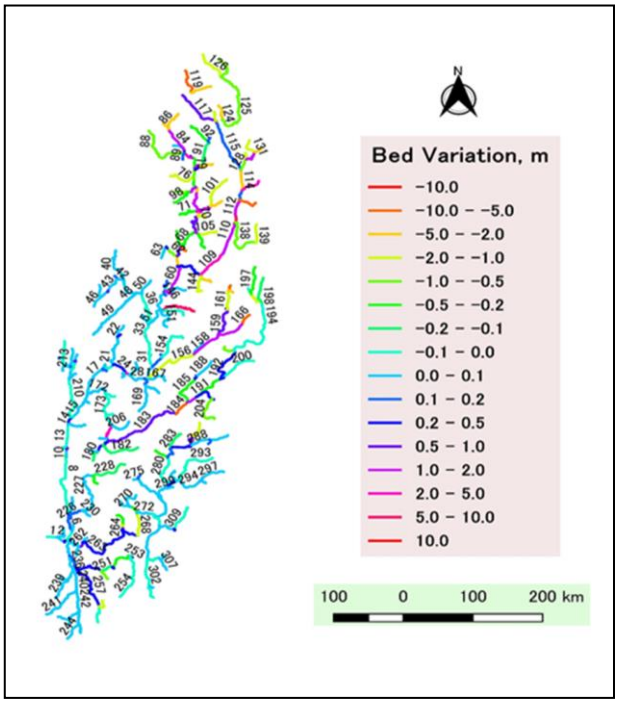

Fig.5 Calculation Results for the river bed deformation in the research area

Reference

(1) Kazuki YAMANOI, Masaharu FUJITA: Development of a Combined Model of Sediment Production, Supply and Transport and its Application to a Mountainous Basin, Journal of JSCE, Ser. B1 (Hydraulic Engineering), Vol. 70, No. 4, p.l_925-l_930, 2014.

(2) Swe Hlaning Win, 2011, Sediment Dynamics in Irrawaddy River, Myanmar; A Thesis submitted for the Degree of Master of Social Science, Department of Geography, National University of Singapore.

(3) Hnin Thiri Myo, Win Win Zin, Forecasting Climate Change Scenarios in Central Dry Zone of Myanmar, Department of Civil Engineering, Yangon Technological University, Myanmar.